IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Bell

Serial No.: 09/864,064

Group Art Unit: 3726

Filed: May 23, 2001

Examiner: P. Echols

For: CAST INTEGRAL RING GEAR AND DIFFERENTIAL CASE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

APPEAL BRIEF

Subsequent to the Notice of Appeal mailed to the Patent and Trademark Office on December 8, 2003 and received by the USPTO on December 10, 2003, Appellant now submits its Appeal Brief. Fees in the amount of $330.00 can be charged to Deposit Account No. 50-1482 in the name of Carlson, Gaskey & Olds, PC.

REAL PARTY IN INTEREST

The real party in interest is Meritor Heavy Vehicle Technology, LLC. Meritor Heavy Vehicle Technology, LLC is the Assignee of all right and title in this Application from the inventor.

RELATED APPEALS AND INTERFERENCES

There are no pending related appeals or interferences.

STATUS OF CLAIMS

Claims 1-9 stand finally rejected, and more specifically, all of the claims stand rejected under §103(a) over the admitted prior art (APA) in view of Tagawa. The final rejection of all of the pending claims is being appealed.

STATUS OF AMENDMENTS

All of the amendments have been entered.

SUMMARY OF THE INVENTION

This invention relates to a differential assembly for use in an axle, and more particularly, the invention relates to a ring gear and differential case used in a differential assembly.

As discussed on page 1 of the Specification, differential assemblies are commonly used in axles and other rotational transmission devices to provide relative rotation between shafts arranged along a common axis. The differential assembly typically receives rotational input from a drive shaft transverse to the common axis. The rotational input is transmitted through the differential assembly by a ring which is secured to a differential case. The differential case

supports the ends of the shafts and the gears necessary to permit relative rotation of the shafts.

The ring gear is typically secured to differential case using numerous bolts, nuts and washers, which add costs and weight to the differential assembly. The ring gear and differential case are manufactured separately and secured to one another, which in part is necessitated by the different materials usually utilized to construct each of the components. The ring gear is typically constructed from a forged steel to withstand the large input forces transmitted through the drive shaft, and the differential case is typically constructed from a ductile iron or cast steel.

One proposed solution to eliminate the fastening components of the prior art was to manufacture the ring gear and differential case as a single unit from forged steel. However, utilizing forged steel for the entire differential assembly may increase the overall weight of the assembly because of the increased density of forged steel as compared to ductile iron. Moreover, forging such a large component increases the cost of the differential assembly. Therefore, what is needed is a method and apparatus of securing the ring gear to the differential case.

Referring to page 2 of the Specification, a differential assembly 10 is shown in Figure 1. The differential assembly 10 includes a differential case 12, which is preferably constructed from ductile iron. The differential case 12 includes opposing ends 14 that receive and support opposing axle shafts, which are not shown in the Figure. While the differential assembly 10 is discussed with reference to vehicle axles, it is to be understood that the present invention may be utilized for other applications. The differential case 12 includes a central portion 16 having a spider 18 supporting differential pinions 20, which engage side gears on the axle shafts. The differential case shown is a

two-piece configuration with fasteners 22 securing the pieces together. However, it is to be understood that the invention may be used for any differential assembly configuration. The spider 18, pinions 20, and fasteners 22 are installed after the casting and machining processes discussed below.

With reference to page 3 of the Specification, the differential case 12 further includes a flange 24 extending radially from the case 12. In the prior art, a ring gear 26 has been secured to the differential case 12 by fastening the ring gear 26 to the flange 24 utilizing numerous fasteners. The ring gear 26 includes a plurality of teeth 28 which receive rotational input from a drive shaft and pinion, which are not shown. The axle shafts are permitted to rotate relative to one another while receiving rotational input through the ring gear 26, as is well known in the art. The ring gear 26 is preferably constructed from a forged steel to withstand the large forces generated at the gear teeth 28.

According to the present invention, the differential assembly 10 is formed by casting the differential case 12 about a portion of the ring gear 26 to secure the ring gear 26 and differential case 12 to one another. In this manner, the ring gear 26 and differential case 12 may be constructed from dissimilar materials and the fasteners typically used to secure the case and gear to one another may be eliminated. Preferably, the ring gear 26 includes projections 30 extending from the mounting portion 29 of the ring gear. The projections 30 enhance the connections between the ring gear 26 and case 12 and ensure that torque may be effectively transmitted from the ring gear 26 to the differential case 12 without dislodging the gear 26 from the case 12. Most preferably, the flange

24 is cast about the projections 30, which are opposite the teeth 28. In addition to or instead of the utilizing projections 30 extending from the rear of the gear 26 as shown, projections 30 may also extend from the inner diameter of the ring gear 26, or any other suitable location.

As discussed on page 4 of the Specification, a process that may be used to manufacture the differential assembly 10 of the present invention is depicted in Figure 2. The ring gear is formed, as indicated at 40. The ring gear may be formed by any suitable process, but is preferably formed by a precision forging process that yields a near-net-shape ring gear, which requires a reduced amount of machining as compared to other forging processes. The ring gear is forged from a suitable material such as forging steels known in the art. The forged ring gear may then be inserted into a mold to cast integral with the differential case 12, as indicated at 42. The differential case may be cast from a ductile iron and is cast about a portion of the ring gear such as the projections 30. The teeth on the ring gear and other features of the ring gear and differential case may be machined, as indicated at 44. Preferably, the case 12 is machined prior to the gear 26 so that the gear 26 may be machined with reference to machined features on the case 12. The teeth may then be hardened, as indicated at 46, utilizing an induction hardening or other suitable process, as is known in the art.

ISSUE

I. Is the combination of the APA and Tagawa proper?

II. Is the Examiner's refusal to provide evidence proper when Official Notice is taken?

III. Can the Examiner merely allege "design choice" without providing a motivation to combine?

GROUPING OF CLAIMS

The term "contested" means that Appellant is appealing the rejection provided by the Examiner to the particular claim or claims. The claims are grouped together by letter, and the claims within a particular group stand or fall together. However, the claims of one group do not stand or fall with the claims of another group.

A. The rejections of claims 1-9 are contested.

B. The rejection of claim 3 is separately contested.

C. The rejections of claims 7-9 are separately contested.

ARGUMENTS

A. There is no motivation to combine the APA and Tagawa.

Claims 1-9 were rejected under §103 over the Admitted Prior Art (APA) in view of Tagawa. The APA discloses a ring gear secured to a differential case by fasteners. The APA does not disclose casting the differential case onto the ring gear, which the Examiner argues is obvious in view of the teachings of Tagawa. The Examiner further argues that one of ordinary skill would modify the APA with the casting of Tagawa "to eliminate the fasteners and to quickly attach the gear to the housing." In the disclosure of Tagawa, the outer ring and stator are not connected by fasteners. The problems Tagawa attempt to overcome are 1) too thick of an outer

ring which results in a large package, 2) too thin of a stator which can lead to breakage, and 3) too wide of an outer ring and poor structural integrity. There is no mention of fasteners in Tagawa. Accordingly, the Examiner cannot argue that the motivation to one of ordinary skill in the art to modify APA in view of the teachings of Tagawa would be to eliminate the fasteners. The Examiner cannot sustain the rejection to claims 1-9 with the present combination.

The Examiner on page 2 of the September 8, 2003 Office Action argues that no explicit teaching is necessary and one of ordinary skill would realize that fasteners would not be necessary when casting the housing on the ring. The Examiner misses the point. The Tagawa disclosure in no way teaches that the Tagawa invention is useful for eliminating fasteners. What then is the motivation for one of ordinary skill to combine? All it teaches is a rotor and stator arrangement developed to address the three problems outlined above. The Tagawa solution is for problems in no way relevant to the problems presented in the APA, and therefore, one of ordinary skill would not combine the references.

B. There is no motivation to combine the references relative to claim 3.

Applicants have challenged the Examiner's Office Notice of near-net forging as a process. However, the Examiner must still provide a motivation as to one of ordinary skill would use this process on a ring gear in the claimed combination. The Examiner must produce a reference that would provide the necessary suggestion or motivation to one of ordinary skill to provide this limitation, which is missing from the Examiner's cited references. The Examiner has failed to

comply with MPEP 2144.03 C., p. 2100-133. The Examiner must withdraw the rejection to claim 3.

C. There is no motivation to combine the references relative to claims 7-9.

The Applicants challenge the Examiner's comments regarding machining the teeth or casing as being an "obvious matter of design choice." With respect to claims 7-9, Applicants are claiming a sequence of steps not disclosed in the prior art. The claimed sequence is desirable when casting a differential case onto a ring gear. The Examiner has not cited anything in the prior art that indicates that the claimed sequence necessarily follows from casting the differential case onto the ring gear. Without providing this, the Examiner cannot sustain the rejection of claims 7-9. Furthermore, it is not clear how the Examiner's mention of no disclosure of "new or unexpected results" is relevant. On page 4 of the Specification, Applicants describe why the claimed procedure is desirable.

The Examiner argues on page 3 of the September 8, 2003 Office Action that one of ordinary skill "would be aware of the advantages" with respect to the claimed sequence. The Examiner is merely alleging this and has not supported this argument with the cited references to provide the requisite motivation (see MPEP 2144.04 IV. C., p. 2100-136). If the Examiner is attempting to take Official Notice, then the Examiner must provide evidence (see heading B above).

CLOSING

For the reasons set forth above, the final rejection of all claims is improper and must be reversed. An early indication of such is earnestly solicited.

Respectfully submitted,

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CLAIM APPENDIX

1. (Original) A method of forming a differential assembly comprising the steps of:

a) providing a ring gear; and

b) casting a differential case around a portion of the ring gear to form the differential assembly.

2. (Original) The method according to claim 1, wherein step a) includes forging the ring gear.

3. (Original) The method according to claim 2, wherein step a) includes precision forging the ring gear to a near-net-shape.

4. (Original) The method according to claim 1, wherein the ring gear is steel.

5. (Previously presented) The method according to claim 6, wherein the differential case is ductile iron.

6. (Original) The method according to claim 1, wherein the portion includes projections for an improved connection between the ring gear and the differential case.

7. (Previously presented) The method according to claim 1, further including the step of:

c) machining differential case features subsequent to performing step b).

8. (Previously presented) The method according to claim 7, further including the step of:

d) machining gear teeth on the ring gear subsequent to performing step c).

9. (Previously presented)The method according to claim 8, further including the step of:

e) induction hardening the gear teeth subsequent to performing step d).

10. (Withdrawn) A differential assembly comprising:

a ring gear having a plurality of teeth and a mounting portion spaced from said teeth; and

a differential case including a cast portion surrounding said mounting portion securing said ring gear to said differential case.

11. (Withdrawn) The assembly according to claim 10, wherein said ring is steel.

12. (Withdrawn) The assembly according to claim 11, wherein said steel is forged.

13. (Withdrawn) The assembly according to claim 10, wherein said differential case is ductile iron.

14. (Withdrawn) The assembly according to claim 10, wherein said mounting portion includes projections for an improved connection between said ring gear and said differential case.

15. (Withdrawn) The assembly according to claim 14, wherein said cast portion is a flange.